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MTM400A, IPM400A, and RFM300 DTV Monitors Specifications and Performance Verification

Technical Reference

077-0176-02

Tektronix

MTM400A, IPM400A, and RFM300
DTV Monitors
Specifications and Performance Verification

Technical Reference

This document applies to firmware versions 4.0 and above.

www.tektronix.com

077-0176-02

Tektronix

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- Worldwide, visit www.tektronix.com to find contacts in your area.

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The inputs are not rated for connection to mains or Category II, III, or IV circuits.

Power Disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Do Not Operate With Suspected Failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in this Manual

These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:

CAUTION
Refer to Manual

Protective Ground
(Earth) Terminal

Preface

This manual contains the following information about the MTM400A, IPM400A, and RFM300 DTV Monitors:

- *Specifications* lists the electrical, physical, and environmental specifications of the DTV monitors.
- *Performance Verification* contains a procedure to verify that the DTV monitors is operating normally.

Product Documentation

Table i lists the product documentation supporting the DTV monitor.

Table i: Product documentation

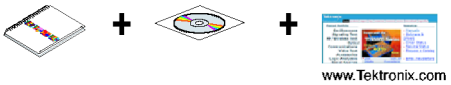
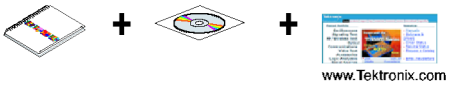
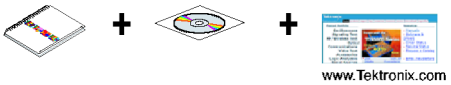
Item (Tektronix part number)	Purpose	Location
MTM400A DTV Monitor Quick Start User Manual (071-2492-xx English, 071-2493-xx Japanese 071-2632-xx German)	Provides installation and high-level operational overviews	
IPM400A DTV Monitor Quick Start User Manual (071-2698-xx English)	Provides installation and high-level operational overviews	
RFM300 DTV Monitor Quick Start User Manual (071-2700-xx English)	Provides installation and high-level operational overviews	
MTM400 and MTM400A RUI v3.x Upgrade Technical Reference (077-0174-xx)	Describes the remote user interface (RUI) changes introduced with the MTM400A monitor	
MTM400A, IPM400A, and RFM300 Technical Reference (077-0175-xx)	Provides in-depth operating information	
MTM400A, IPM400A, and RFM300 Specifications and Performance Verification Technical Reference (077-0176-xx)	Provides complete product specifications and a procedure for verifying the operation of the instrument (this document)	
MTM400A, IPM400A, and RFM300 Read This First (071-2654-xx)	Describes late breaking product information and operational issues	
MTM400A, IPM400A, and RFM300 Test Parameter and Configuration File Technical Reference (077-0177-xx)	Provides information about using test parameters and configuration files	
MTM400A, IPM400A, and RFM300 Programmer Manual (077-0178-xx)	Provides information about remote command syntax	

Table i: Product documentation (cont.)

Item (Tektronix part number)	Purpose	Location
MTM400A, IPM400A, and RFM300 Declassification and Security Instructions (077-0179-xx)	Provides instructions for removing your proprietary information from the instrument	www.Tektronix.com
MTM4UP Upgrade Instructions (075-0973-xx)	Provides instructions for upgrading the MTM400A DTV Monitor	www.Tektronix.com
IPM4UP Upgrade Instructions (075-0997-xx)	Provides instructions for upgrading the IPM400A DTV Monitor	www.Tektronix.com
RFM3UP Upgrade Instructions (075-0993-xx)	Provides instructions for upgrading the RFM300 DTV Monitor	www.Tektronix.com

Specifications

This section lists the electrical, environmental, and physical specifications of the DTV monitors. All specifications are guaranteed unless labeled typical. Typical specifications are provided for your convenience and are not guaranteed. Electrical characteristics apply to test systems operating within the environmental conditions.

Electrical, Hardware, and Signal Specifications

Table 1: Remote User Interface (RUI) platform characteristics

Characteristic	Description
Minimum Specification	1.2 GHz Intel Pentium Processor (Preferred: 2 GHz)
Operating System	Microsoft Windows operating systems Windows 2000, Windows XP, and Windows Vista (Recommended: Windows XP Pro)
Disk Space	2 GB free disk space
Ethernet	10/100-base T
Installed Software	Microsoft Internet Explorer, Version 7.0 minimum; Sun Java Runtime Environment Version 6 Update 3 minimum (1.6.0_10)
RAM	1 GB
CD-ROM Drive	8x
Display	1024 x 768 pixel video monitor with 16 bit (65000) available colors

Table 2: TS processor card - system timing clock

Characteristic	Description
PCR Offset Measurement Accuracy	± 2.0 ppm
System Timing Clock Drift	± 1.0 ppm per year (maximum)

Table 3: TS processor card - ASI interface

Characteristic	Description
ASI Input	
Connector	BNC
Transport Stream Rate	155 Mbps maximum, 250 kbps minimum
Data Format	Accepts both Burst and Packet mode ASI format
Signal Amplitude	2.0 V_{p-p} maximum; 200 mV_{p-p} minimum
Termination	75 Ω nominal, transformer coupled
Return Loss	10 dB min, 5 MHz to 270 MHz
Link Rate	270 Mbaud ± 100 ppm

Table 3: TS processor card - ASI interface (cont.)

Characteristic	Description
ASI Output	(The Output is an active loopthrough of the Input.)
Connector	BNC
Impedance	75 Ω nominal, transformer coupled
Transport Stream Rate	Same as the ASI input
Signal Amplitude	1.0 V_{p-p} max, 600 mV_{p-p} min, into a 75 Ω load
Return Loss	10 dB min at 270 MHz

Table 4: TS processor card - SMPTE310M interface

Characteristic	Description
SMPTE310M Input	
Connector	BNC
Termination	75 Ω , transformer coupled
Data Format	Bi-phase coded. Compliant with SMPTE310M
Input Bit Rate	19,392,658.5 bps ± 2.8 ppm
Signal Amplitude	2.0 V_{p-p} maximum, 200 mV_{p-p} minimum
Return Loss	10 dB min at 20 MHz
SMPTE310M Output	(The Output is an active loopthrough of the Input.)
Connector	BNC
Output Bit Rate	Same as the SMPTE310M input
Signal Amplitude	600 mV min, 1.0 V max, into a 75 Ω load
Output Impedance	75 Ω , transformer coupled
Return Loss	10 dB min at 20 MHz

Table 5: TS processor card - alarm connector

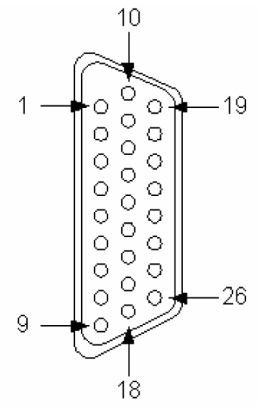
26-Pin, D-type connector	Pin	Function	Description
	1	DGND	Ground
	2	TTL02	TTL Output 2
	3	DGND	Ground
	4	P5V	5 V
	5	RL1NC	Relay 1: Normally closed contact
	6	RL2NC	Relay 2: Normally closed contact
	7	RL3NC	Relay 3: Normally closed contact
	8	RL4NC	Relay 4: Normally closed contact
	9	RL5NC	Relay 5: Normally closed contact
	10	DGND	Ground
	11	DGND	Ground
	12	TTL03	TTL Output 3
	13	P5V	5 V
	14	RL1CC	Relay 1: Common contact
	15	RL2CC	Relay 2: Common contact
	16	RL3CC	Relay 3: Common contact
	17	RL4CC	Relay 4: Common contact
	18	RL5CC	Relay 5: Common contact
	19	TTL01	TTL Output 1
	20	DGND	Ground
	21	TTLI1	TTL Input 1
	22	RL1NO	Relay 1: Normally open contact
	23	RL2NO	Relay 2: Normally open contact
	24	RL3NO	Relay 3: Normally open contact
	25	RL4NO	Relay 4: Normally open contact
	26	RL5NO	Relay 5: Normally open contact
	Connector shell - Chassis ground		

Table 6: TS processor card - alarms

Characteristic	Value
Alarm Relay	
Number of relays	5
Maximum Switching Current	1 Amp
Maximum Switch Voltage	24 V_{DC}
Contact Resistance	100 milli-Ω max
TTL Output Pins of the Alarms Output Connector	
Output Type	TTL open collector, requires external pull-up resistor
Logic High Voltage	2.0 V min
Logic Low Voltage	0.8 V max, sinking 100 mA
Maximum Switching Current	100 mA
TTL Input Pins of the Alarms Output Connector	
Maximum Input Voltage	5.1 V
Logic High Input Voltage	2.0 V min
Logic Low Input Voltage	0.8 V max
+5 V Output, Pins 4 and 13 of the Alarms Output Connector	
Output Voltage	4.9 V min, 5.1 V max, no load
Maximum Output Current	100 mA
Output Protection	Fused, self resetting

Table 7: TS processor card - LTC connector

LTC 2-pin connector	Pin	Function	Description
	1	IN+	
	2	IN-	
	Connector shell - Chassis ground		
Port Specification			
Type	Linear time code, SMPTE standard to ANSI/SMPTE 12M - 1995		
Input Voltage	2.0 V p-p differentially minimum		

Table 8: TS processor card - Ethernet RJ-45 connector

Characteristic	Description
Connector	10/100 Base-T; RJ-45 Use only good quality screened cable; Cat 6

Table 9: QAM Annex A interface card characteristics

Characteristic	Description
Input Frequency Range	51 MHz to 858 MHz, 62.5 kHz steps
Modulation Format	16 QAM, 64 QAM, 256 QAM (compliant with DVB-C ETS 300 421)
Modulation Baud Rate, QAM A	5.0 Mbaud/s minimum, 6.952 Mbaud/s maximum
Input Signal Level	-57 dBm (50 dBuV) to -27 dBm (80 dBuV), with a 16, 64, and 256 QAM input, providing five or fewer Transport Error Flags in 10 seconds, which corresponds to a post FEC rate of $1e^{-8}$
Modulation Error Ratio (with equalizer)	38 dB min, with a 64 QAM input and 256 QAM input
Receiver Bandwidth, QAM A	8 MHz nominal
Input Termination Impedance	75 Ω nominal
Input Return Loss	6 dB min, 10 dB typical, 51 MHz to 858 MHz
Loop Through Power Gain	1.5 dB to 4 dB typical, 51 MHz to 858 MHz typical
Loop Through Noise Figure	8 dB typical
Loop Through Output Return Loss	Greater than 10 dB typical

Table 10: QAM Annex B2 interface card characteristics

Characteristic	Description
Input Frequency Range	88 MHz to 858 MHz
Input Signal Level	-64 dBm to -19 dBm (45 dBuV to 90 dBuV relative to 75 Ω) (With either a 64 or 256 QAM input, there are five or fewer Transport Error Flags in 11 seconds, which corresponds to a post FEC rate of $1e^{-8}$) ≥ -55 dBm to ensure compliance to EN 55103-2 immunity
Modulation Format	64 QAM, 256 QAM (compliant with ITU J-83 Annex B)
Interleaving Mode	Level 1 and Level 2 interleaving support compliant with all ITU J-83 Annex B, excluding I, J = (128,7) and (128,8), and in 256 QAM excluding (8, 16) and (16, 8)
Modulation Baud Rate	64 QAM: 5.056941 Mbaud/s 256 QAM: 5.360537 Mbaud/s
Spectrum Polarity	Demodulates both Normal and Inverted IF Spectrum.
Receiver Bandwidth, QAM B	6 MHz nominal
Connector Type	F type
Input Termination Impedance	75 Ω nominal
Input Return Loss	5 dB typical
Ultimate Modulation Error Ratio with Equalizer	≥ 37 dB with equalizer; typical

Table 11: QAM Annex B2 measurements

Characteristic	Description
RF Lock	RF lock is indicated by LED and Status
Input Level (Signal Strength) (Typical)	Range: -64 dBm to -19 dBm (45 dBuV to 90 dBuV relative to 75 Ωs) Resolution: 1 dB Accuracy: ± 3 dB

Table 11: QAM Annex B2 measurements (cont.)

Characteristic	Description
EVM (Error Vector Magnitude) (Typical)	Display Range for 64 QAM: ≤ 1% to ≥ 5% rms Display Range for 256 QAM: ≤ 1% to ≥ 2.5% rms Resolution: 0.1% Accuracy: "1%
MER (Modulation Error Ratio) with Equalizer (Typical)	Display Range: 64 QAM: 22 dB to 37 dB 256 QAM: 28 dB to 37 dB Resolution: 0.1 dB Accuracy: ± 1 dB for MER < 25 dB; (plus-min) 3 dB for MER 25 dB to 34 dB (measured at -30 dBm input)
SNR (Signal to Noise Ratio) (Typical)	Display Range: 64 QAM: 22 dB to 37 dB 256 QAM: 28 dB to 37 dB Resolution: 1 dB Accuracy: "1 dB for SNR < 25 dB; ± 3 dB for SNR 25 dB to 34 dB
BER (Bit Error Ratio)	Pre-RS BER is displayed
TEF (Transport Error Flag)	Transport Error Flags (uncorrectable error count) in a 1 second window and 10 second window are displayed.
Constellation	The RF constellation is displayed.

Table 12: QAM Annex C interface card characteristics

Characteristic	Description
Input Frequency Range	88 MHz to 858 MHz, 62.5 kHz steps
Modulation Format	16 QAM, 64 QAM, 256 QAM (compliant with ITU J-83 Annex C)
Modulation Baud Rate, QAM C	4.5 Mbaud/s min; 5.5 Mbaud/s max
Input Signal Level	-57 dBm (50 dBuV) to -27 dBm (80 dBuV), with a 16, 64, and 256 QAM input, providing five or fewer Transport Error Flags in 12 seconds, which corresponds to a post FEC rate of $1e^{-8}$
Modulation Error Ratio (with equalizer)	38 dB typical, with a 64 QAM input
Receiver Bandwidth, QAM C	6 MHz nominal
Input Termination Impedance	75 Ω nominal
Input Return Loss	6 dB min, 10 dB typical, 88 MHz to 858 MHz

Table 13: 8PSK/QPSK interface card characteristics with 8PSK input

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz with 1 MHz step size
Input Signal Amplitude Range	-60 dBm to -30 dBm for a CBER of $<1e^{-6}$
Modulation Format	QPSK in accordance with ETSI EN 300 421
Modulated Baud Rate	1 MBaud min, 30 MBaud max
Turbo Viterbi Values Supported	2/3, 3/4 (2.05), 3/4 (2.1), 5/6, 8/9

Table 13: 8PSK/QPSK interface card characteristics with 8PSK input (cont.)

Characteristic	Description
Turbo FEC	Turbo code
Connector Style	F-style
Input Termination Impedance	75 Ω nominal
Input Return Loss	4 dB min, 950 MHz to 2050 MHz typical
LNB Supply Voltage	Selectable; 13.0 V ± 1.5 V or 18.0 V (plus-min) 1.5 V, with 100 Ω, 5 watt resistor load
LNB Supply Maximum Current	200 mA maximum
LNB 22 kHz Signaling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz ± 20%)
LNB 22 kHz Signaling Amplitude	600 mV p-p with 100 Ω load
Ultimate Modulation Error Ratio (with equalizer)	26 dB with equalizer

Table 14: 8PSK/QPSK interface card characteristics with QPSK input

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz with 1 MHz step size
Input Signal Amplitude Range	-60 dBm to -30 dBm for a CBER of $<1e^{-6}$
Modulation Format	QPSK in accordance with ETSI EN 300 421
Modulated Baud Rate	1 MBaud min, 30 MBaud max
Viterbi Values Supported	1/2, 2/3, 3/4, 5/6, 6/7, 7/8
FEC	In accordance with ETSI EN 300 421
Turbo Viterbi Values Supported	1/2, 2/3, 3/4, 5/6, 7/8
Turbo FEC	Turbo code
Connector Style	F-style
Input Termination Impedance	75 Ω nominal
Input Return Loss	4 dB min, 950 MHz to 2050 MHz typical
LNB Supply Voltage	Selectable; 13.0 V ± 1.5 V or 18.0 V (plus-min) 1.5 V, with 100 Ω, 5 watt resistor load
LNB Supply Maximum Current	200 mA maximum
LNB 22 kHz Signaling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz ± 20%)
LNB 22 kHz Signaling Amplitude	600 mV p-p with 100 Ω load
Ultimate Modulation Error Ratio (with equalizer)	26 dB with equalizer

Table 15: 8PSK and QPSK measurements

Characteristic	Description
RF Lock	RF lock is indicated by LED and Status.
Input Level (Signal Strength)	Range: -60 dBm to -30 dBm; Resolution: 1 dBm; Accuracy: ± 5 dBm; typical

Table 15: 8PSK and QPSK measurements (cont.)

Characteristic	Description
EVM (Error Vector Magnitude)	Display Range: ≤ 4.0% to ≥ 30.0% rms; Resolution: 0.1%; Accuracy: ± 20% of reading; typical
MER (Modulation Error Ratio) with Equalizer	Display Range: 10 dB to 26 dB with equalizer; Resolution: 1 dB; Accuracy: ± 2 dB for range 10 dB to 20 dB; typical
SNR (Signal to Noise Ratio)	Display Range: 5 dB to 35 dB; Resolution: 1 dB; Accuracy: ± 2 dB for range from 5 dB to 30 dB; typical
Pre Reed Solomon (RS) BER (Bit Error Rate)	Pre-RS BER is displayed.
Post RS BER and TEF (Transport Error Flag)	Post Reed Solomon BER (TEF ratio), TEF rate, and number of Transport Error Flags (TEF count) are displayed.
Constellation	The RF constellation is displayed.

Table 16: DVB-S2 interface card characteristics

Characteristic	Description
Input Frequency Range	950 MHz to 2150 MHz with 1 MHz step size
Input Signal Amplitude Range	-60 dBm to -30 dBm for a CBER of $<1e^{-6}$
Modulation Format	QPSK in accordance with DVB-S (ETSI EN 300 421)
Modulated Baud Rate	1 MBaud min, 60 MBaud max
Viterbi Values Supported	DVB–S: 1/2, 2/3, 3/4, 5/6, 6/7, 7/8 DVB-S2: 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10
FEC modes	Viterbi and Reed-solomon in accordance with DVB-S. LDPC (low density parity check) and BCH in accordance with DVB-S2. Short and Normal FEC blocks in accordance with DVB-S2.
Roll Off	0.2, 0.25, 0.35
Connector Style	F-style
Input Termination Impedance	75 Ω nominal
Input Return Loss	> 6 dB min, 950 MHz to 2150 MHz typical
LNB Supply Voltage	Selectable; 13.0 V ± 1.5 V or 18.0 V ± 1.5 V, with 100 Ω , 5 watt resistor load
LNB Supply Maximum Current	200 mA maximum
LNB 22 kHz Signaling Frequency	17.6 kHz min, 26.4 kHz max (22 kHz ± 20%)
LNB 22 kHz Signaling Amplitude	800 mV p-p with 100 Ω load
LNB Mode	DiSEqC 2 (Digital Satellite Equipment Control)

Table 17: DVB-S2 measurements

Characteristic	Description
RF Lock	RF lock is indicated by LED and Status.

Table 17: DVB-S2 measurements (cont.)

Characteristic	Description
Input Level (Signal Strength)	Range: -60 dBm to -30 dBm; Resolution: 1 dBm; Accuracy: ± 5 dBm; typical
EVM (Error Vector Magnitude)	Display Range: ≤ 4.0% to ≥ 30.0% rms; Resolution: 0.1%; Accuracy: ± 20% of reading; typical
MER (Modulation Error Ratio) with Equalizer	Display Range: 10 dB to 30 dB with equalizer; Resolution: 1 dB; Accuracy: ± 2 dB for range 10 dB to 28 dB; typical
CNR (Carrier to Noise Ratio)	Display Range: 10 dB to 30 dB; Resolution: 1 dB; Accuracy: ± 2 dB for range from 10 dB to 28 dB; typical
Phase Noise	Display Range: 5º to 45º; Resolution: 1º
Pre Viterbi BER	Pre-Viterbi BER is displayed.
Pre Reed Solomon (RS) BER (Bit Error Rate)	Pre-RS (Reed-Solomon) BER is displayed.
Pre LDPC BER	Pre-LDPC (Low Density Parity Check) BER shall be displayed.
Pre BCH BER	Pre-BCH (Bose-Chaudhuri-Hocquengham) BER shall be displayed
Post RS BER and TEF (Transport Error Flag)	Post Reed-Solomon BER (TEF ratio), TEF rate, and number of Transport Error Flags (TEF count) are displayed.
Transmission Parameters	All Coding and Modulation parameters are displayed
Constellation	The RF constellation is displayed.

Table 18: 8VSB interface card characteristics

Characteristic	Description
Input Frequency Range	54 MHz to 860 MHz, VHF/UHF channels 2 to 69 (to include low VHF frequencies)
Input Signal Level	-72 dBm to -6 dBm (-23 dBmV to +43 dBmV) ≥ -60 dBm to ensure compliance to EN 55103-2 immunity
Modulation Format	8VSB in accordance with ATSC A/53B.
Receiver Bandwidth	6 MHz
Input Termination Impedance	75 Ω nominal
Connector Type	F type
Input Return Loss	5 dB minimum; typical

Table 19: 8VSB measurements

Characteristic	Description
RF Lock	RF lock is indicated LED and Status
Input Level (Signal Strength) (Typical)	Display Range: -72 dBm to -2 dBm relative to 75 Ω (-23 dBmV to +47 dBmV) Resolution: 1 dB Accuracy: ± 3 dB
EVM (Error Vector Magnitude) (Typical)	Display Range: ≤ 3.0% to ≥ 12.5% rms Resolution: 0.1% Accuracy: ± 20% of reading

Table 19: 8VSB measurements (cont.)

Characteristic	Description
Equivalent MER (Modulation Error Ratio) with Equalizer (Typical)	Display Range: 17 dB to 31 dB with Equalizer Resolution: 0.1 dB Accuracy: ± 1 dB for MER > 25 dB; (plus-min) 3 dB for MER 25 dB to 31 dB (Measured at -30 dBm input. For best MER accuracy, maintain the input signal level between -50 dBm and -15 dBm.)
SNR (Signal to Noise Ratio) (Typical)	Display Range: 15 dB to 35 dB Resolution: 1 dB Accuracy: ± 1 dB for SNR < 25 dB; (plus-min) 3 dB for SNR 25 dB to 35 dB
BER	Pre-RS BER, SER 1 second and 10 seconds windows values are displayed.
TEF (Transport Error Flag)	Transport Error Flags (uncorrectable error count) in a 1 second window and 10 second window are displayed.
Constellation Diagram	The 8VSB constellation diagram is a display of I-data history with histograms (the IQ constellation is not available). This is displayed as Symbol Distribution in the user interface.
Echo Profile (Typical)	Equalizer filter tap information is displayed. Display Echo Level range: Normalized real tap values over the range of -1 to 1 Display Delay range: -6.7 µs to 45.5 µs

Table 20: COFDM interface card characteristics

Characteristic	Description
Input Frequency Range	50 MHz to 858 MHz (to include low VHF)
Input Signal Amplitude Range	The receiver delivers QEF (Quasi Error Free) operation over the following signal power ranges: QPSK (4 QAM): -85 dBm to -10 dBm (24 dBuV to 99 dBuV) 16 QAM: -80 dBm to -10 dBm (29 dBuV to 99 dBuV) 64 QAM: -72 dBm to -15 dBm (37 dBuV to 94 dBuV) ≥ -60 dBm to ensure compliance to EN 55103-2 immunity
Compliance	COFDM (DVB-T) receptions and demodulation, compliant with ETSI EN300-744, 2 K and 8 K transmission modes
Tuning Resolution	166.7 kHz or smaller increments
Tuning Accuracy	Better than ± 50 ppm
Channel Bandwidth	6 MHz, 7 MHz, and 8 MHz (software selectable)
Connector Style	F-style
Input Termination Impedance	75 Ω nominal
Input Return Loss	7 dB minimum, 50 MHz to 858 MHz; typical
Modulation Schemes Supported	QPSK (4 QAM), 16 QAM, and 64 QAM modulation
Transmission Modes	2 K carriers and 8 K carriers
Hierarchical modulation	All hierarchies will be supported, to include no hierarchy, and alpha = 1, 2 and 4.
Viterbi puncture rates	1/2, 2/3, 3/4, 5/6, 7/8
Guard Intervals	1/32, 1/16, 1/8, 1/4
Spectrum Polarity	The receiver will operate with both inverted and normal spectral polarity.
Ultimate Modulation Error Ratio, with Equalizer	≥ 37 dB with equalizer; typical

Table 21: COFDM measurements

Characteristic	Description
Overall Receiver Lock Status	Overall receiver lock status is indicated by an LED on the rear panel.
Transmission Coding Parameters	The receiver reports the current status of the following transmission parameters: - QPSK/16, QAM/64, QAM encoding - 2K/8K Transmission mode - Hierarchy status (hierarchy on/off, alpha value) - Viterbi puncture rate - Guard Interval Value - Gross bit rate in the channel - Spectrum polarity (inverted/non inverted)

Table 21: COFDM measurements (cont.)

Characteristic	Description
Input Level (Signal Strength) (Typical)	Ranges, High Sensitivity mode: QPSK (4 QAM): -85 dBm to -10 dBm (24 dBuV to 99 dBuV) 16 QAM: -80 dBm to -10 dBm (29 dBuV to 99 dBuV) 64 QAM: -72 dBm to -13 dBm (37 dBuV to 96 dBuV) Ranges, High Resolution mode: QPSK (4 QAM): -45 dBm to -10 dBm (64 dBuV to 99 dBuV) 16 QAM: -45 dBm to -10 dBm (64 dBuV to 99 dBuV) 64 QAM: -45 dBm to -13 dBm (64 dBuV to 96 dBuV) Resolution: 1 dBm Accuracy: ± 3 dBm
RF Carrier Offset	Accuracy: ± 50 ppm, of the tuned frequency; typical
Carrier Power Distribution	The carrier-by-carrier signal-to-noise power ratio is displayed. Channel Flatness in dB can be viewed from spectrum display. Tilt in dB can be viewed from spectrum display.
SNR (Signal to Noise Ratio) (Typical)	Display Range: 6 dB to 40 dB for QPSK (4 QAM): 11 dB to 40 dB for 16 QAM 16 dB to 40 dB for 64 QAM Resolution: 1 dB Accuracy: ± 1 dB to 30 dB SNR (measured at -30 dBm input in high resolution mode)
EVM (Error Vector Magnitude) (Typical)	Display Range: ≤ 1% to ≥ 30% rms, for QPSK ≤ 1% to ≥ 20% rms, 16 QAM ≤ 1% to ≥ 8.5% rms, 64 QAM Resolution: 0.1% Accuracy: 1% (1 EVM unit), and additional ± 20% of reading
MER (Modulation Error Ratio) with Equalizer (Typical)	Both MER Peak and MER Average are displayed as measured across all carriers. Display Range: 6 dB to 37 dB for QPSK (4 QAM) 11 dB to 37 dB for 16 QAM 16 dB to 37 dB for 64 QAM Resolution: 0.1 dB Accuracy: ± 1 dB to 30 dB (Measured at -30 dBm input in High Resolution mode). For best MER accuracy, use High Resolution mode, and maintain the input signal level between -45 dBm and -15 dBm.
Channel Equalization Status	Channel estimate I and Q values for each carrier are displayed.
Constellation	The RF constellation is displayed.
BER	Pre-Viterbi BER and Pre Reed-Solomon BER values are displayed.
Post RS BER and TEF (Transport Error Flag)	Post Reed Solomon BER (uncorrectable error count) and number of Transport Error Flags are displayed.

Table 22: GigE interface card - general characteristics

Characteristic	Description
Ethernet Port	The Ethernet Interfaces supports 1000/100/10 Mbit/s data transmission. The Ethernet Interface to the card will be an IEEE 802.3 compliant 10/100/1000 Ethernet interface supporting 10/100/1000BT, 1000BSX(multi-mode), and 1000BLX(single-mode). Two Ethernet interfaces are available - a copper RJ-45 interface and an MSA (multisource agreement) compliant SFP (Small Form-factor Pluggable) connector. The SFP connector will provide for pluggable optical interfaces. Only one interface, either the copper or optical, will be active at a time for video over IP monitoring. The active interface will be selectable via software control.
Transport stream rate over IP	250 Kbps to 155 Mbps; typical

Table 23: GigE interface card - Ethernet electrical port

Characteristic	Description
Standard	10/100/1000BASE-T IEEE 802.3
Connector Type	RJ-45
Data Format 10/100 Base T	NRZ
Data Format 1000 Base T	Trellis encoded, PAM5 symbols full-duplex on 4-pair Cat-5 UTP per IEEE 802.3ab

Table 24: GigE interface card - Ethernet Optical port

Characteristic	Description
Ethernet Optical Transmitter - General Characteristics	
Optical Operating Mode	Single Mode or Multimode
Connector Type	Duplex data link MSA compliant SFP connector
Standard	1000 BASE-X
Data Format	NRZ
Ethernet Optical Transmitter - Single mode 1550 nm Using Tek supplied SFP module	
Output Power	-2 dBm to +4 dBm; typical
Center Wavelength - 1550 nm	1530 nm Min, 1550 nm Typ, 1570 nm Max; typical
Total Jitter (Peak-to-Peak)	< 170 ps
Extinction Ratio	≥ 9.0 dBm
Ethernet Optical Receiver - Single mode 1550 nm Using Tek supplied SFP module	
Optical Input Power	-26 dBm to -3 dBm, BER 1 X 10^{-12}; typical
Input Wavelength	1270 nm = λ = 1610 nm
Ethernet Optical Transmitter - Single mode 1310 nm Using Tek supplied SFP module	
Output Power	-11 dBm to -3 dBm; typical
Center Wavelength - 1310 nm	1270 nm Min, 1310 nm Typ, 1355 nm Max; typical

Table 24: GigE interface card - Ethernet Optical port (cont.)

Ethernet Optical Transmitter - Single mode 1310 nm Using Tek supplied SFP module	
Total Jitter (Peak-to-Peak)	< 170 ps
Extinction Ratio	≥ 9.0 dBm
Ethernet Optical Receiver - Single mode 1310 nm Using Tek supplied SFP module	
Optical Input Power	-19 dBm to -3 dBm, BER 1 X 10^{-12}; typical
Input Wavelength	1270 nm = λ = 1610 nm
Ethernet Optical Transmitter - Multimode 850 nm Using Tek supplied SFP module	
Output Power	-9.5 dBm to -2 dBm; typical
Center Wavelength - 850 nm	830 nm Min, 850 nm Typ, 860 nm Ma; typical
Total Jitter (Peak-to-Peak)	< 170 ps
Extinction Ratio	≥ 9.0 dBm
Ethernet Optical Receiver - Multimode 850 nm Using Tek supplied SFP module	
Optical Input Power	-17 dBm to 0 dBm, BER 1 X 10^{-12}; typical
Input Wavelength	770 nm = λ = 860 nm

Table 25: GigE interface card - ASI input

Characteristic	Description
Connector	BNC
Transport Stream Rate	250 Kbps to 155 Mbps; typical
Data Format	Accepts both Burst and Packet mode ASI format
Signal Amplitude	2.0 V_{p-p} max; 200 mV_{p-p} min
Termination	75 Ω nominal, transformer coupled
Return Loss	10 dB min, 5 MHz to 270 MHz
Link Rate	270 Mbaud ±3 100 ppm

Table 26: GigE interface card - ASI output (active loopthrough of ASI/SMPTE input or TS from GigE interface card)

Characteristic	Description
Connector	BNC
Impedance	75 Ω nominal, transformer coupled
Transport Stream Rate	250 Kbps to 155 Mbps max
Transport Stream Smoothing	Smoothing mechanism for the TS packets before retransmitting packets out on ASI port
Signal Amplitude	600 mV_{p-p} min, 1.0 V_{p-p} max into a 75 Ω load
Return Loss	10 dB min at 270 MHz

Table 27: GigE interface card - SMPTE310M input (loopthrough to ASI output)

Characteristic	Description
Connector	BNC
Termination	75 Ω nominal, transformer coupled
Data Format	Bi-phase coded. Compliant with SMPTE310M
Input Bit Rate	19,392,658.5 bps ±3 2.8 ppm
Signal Amplitude	2.0 V_{p-p} max; 200 mV_{p-p} min
Return Loss	10 dB min at 20 MHz

Power Source Characteristics

Table 28: AC power source characteristics

Characteristic	Description
Source Voltage	100 V_{AC} to 240 V_{AC}
Frequency Range	50 Hz/60 Hz
Power Consumption	1 A max
Peak Inrush Current	7.2 A peak at 240 V_{AC}, 50 Hz
Fuse Rating	Mains fuse is 3.15 A, 250 V (Not operator replaceable. Refer servicing to qualified service personnel.)

Table 29: Transport stream card batteries

Characteristic	Description
Quantity	2 (In single carrier)
Voltage	3 V
Capacity	210 mAh
Continuous Discharge (Maximum)	3 mA
Overall Dimensions (Single cell)	
Height	3.2 mm (0.13 in)
Width (Diameter)	20 mm (0.79 in)
Battery Type	Tektronix part number: 146-0096-xx

Environmental Characteristics

Table 30: Environmental characteristics

Characteristic	Description
Temperature	
Operating	+5 °C to +40 °C
Nonoperating	-10 °C to +60 °C
Humidity	
Operating	10% to 80% relative humidity up to 31 °C Above 31 °C, decreasing linearly to 50% at 40 °C
Nonoperating	10% to 95% relative humidity, noncondensing
Altitude	
Operating	0 m to 3000 m (9800 ft.)
Nonoperating	0 m to 12000 m (40000 ft.)

Mechanical (Physical) Characteristics

Table 31: Mechanical characteristics

Characteristic	Description
Classification	Transportable platform also intended for 19-inch rack mounted applications, 1RU high.
Overall Dimensions	
Height	44 mm (1.73 in) (1RU)
Width	430 mm (17.13 in)
Depth	600 mm (23.62 in)
Required Clearance	Top and bottom: 0 mm; Sides: Standard 19 in rack mount
Weight	6.0 kg (13.3 lbs); fully loaded
Packaged Dimensions	
Height	241 mm (9.5 in)
Width	590 mm (23.1 in)
Depth	760 mm (30 in)
Weight (Packaged)	9 kg (19.7 lbs)

Performance Verification

To verify that the DTV monitor is operating correctly, perform the following procedure.

Requirements

The DTV monitor must be connected to a network and have a valid IP address as described in the MTM400A, IPM400A, and RFM300 Quick Start User Manuals.

The client PC must satisfy the minimum requirements. (See Table 1 on page 1.)

Procedure

1. Connect the DTV monitor to an Ethernet network.
2. Power on the DTV monitor and wait for the instrument initialization to complete.
3. On a client PC (connected to the same network and subnet mask as the DTV monitor), launch the Microsoft Internet Explorer Web browser.

NOTE. *This procedure describes how to access the DTV monitor RUI using the Microsoft Internet Explorer Web browser. The RUI can also be accessed using the Tektronix Web Monitoring Systems Manager (WebMSM). This is described in the WebMSM User Manual, Tektronix part number 077-0116-xx.*

4. In the Web browser address bar, enter the network identity or the IP address of the DTV monitor, for example: `http://TSMonitor01` or `http://111.222.333.444`.
5. Press **Enter**. A Java applet is downloaded from the DTV monitor and launched. The file size is approximately 1.5 MB; the download time will depend on the network speed and traffic.

CAUTION. *The Java applet will not run unless a temp directory is properly configured on the PC. A temp directory is set up by default in the Windows XP operating system; previous operating systems may require operator action.*

The Java applet will not run unless the Sun Java Virtual Machine is installed. Type java -version at the command prompt to verify that it is installed and that the version is 1.6.0_10 or greater. If it is not installed, you can download the latest version from the Sun Web site, www.java.com\getjava.

If you have to update the Java version on the PC, you will need to restart this procedure at step 3.

6. In the Connect to MTM Device dialog box, select the Login Type from the drop-down list, Administrator or User.
7. Enter the password for the Login Type you selected in step 6. The default password for Administrator is tek; there is no default password for User.
8. Click **Connect** to start the connection process.
9. Read the End User License Agreement if it appears, and then click **I Accept**.
10. When the DTV monitor RUI opens, click **Device** in the button bar to display the Device Information view. (See Figure 1.)
11. In the Device Information view, verify that the Application Firmware Version is 3.2 or greater.
12. If the DTV monitor connects and presents the RUI, and displays the correct application firmware version in the Device Information window, then the instrument is operating normally.

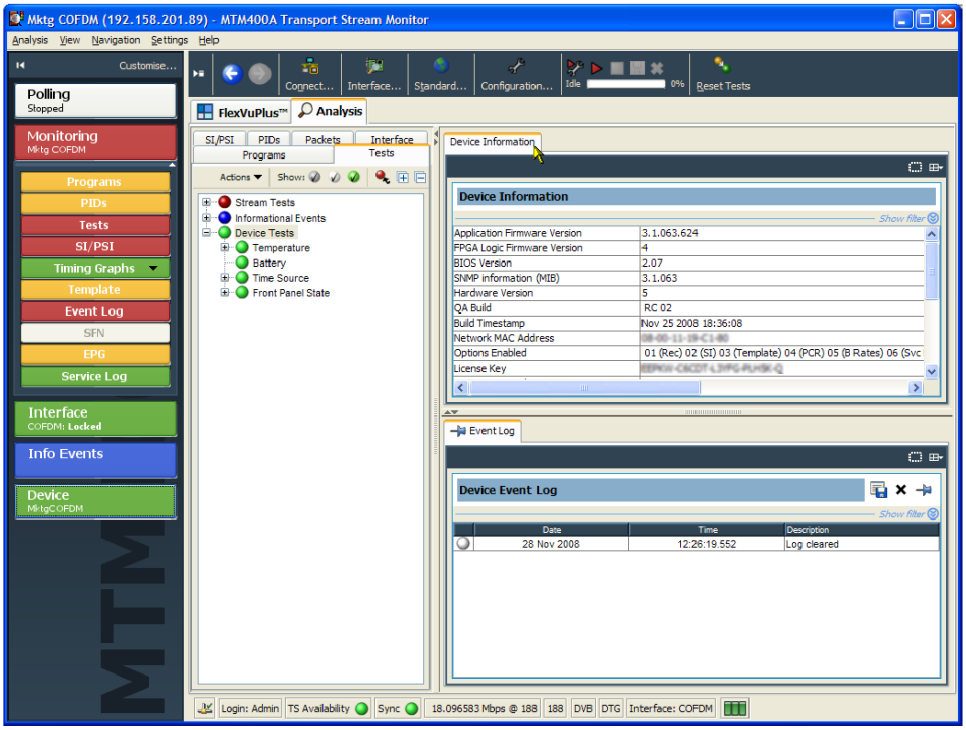


Figure 1: DTV monitor RUI display

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